Miniaturized Sensors for Monitoring of Atmospheric Trace Gases using Multiple Deployment Platforms, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

Daylight Solutions proposes a miniaturized sensor package based on ECqcL

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and QEPAS technology that were independently developed by Daylight Solutions (San Diego, California) and the Laser Science Group Laboratory at Rice University (Houston, Texas) ECqcL

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lasers and QEPAS detectors have been successfully combined into table-top experiments, and the detection of several atmospheric gases in the low ppb range has been demonstrated. ECqcL

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based portable sensors have also been used to demonstrate the detection of 12CO2 and 13CO2 isotopologues at atmospheric CO2 concentrations. The ECqcL

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-QEPAS technique involves tightly focusing an infrared laser beam between the prongs of a commercial quartz tuning fork (QTF). Absorption of the laser emission by the sample heats up the gas between the prongs of the QTF. The resulting pressure spike is detected as an electrical signal due to a deformation of the prongs that results in a charge separation on electrodes deposited on the QTF prongs. Acoustically a QTF is a quadrupole, which results in excellent environmental noise immunity. By scanning the laser over a wide tuning range, the spectra of multiple atmospheric gas species can be recorded using only a single laser. The QEPAS technique does not require a sample chamber and air volumes as small as 1 mm3 containing atmospheric concentrations of 12CO2, 13CO2, CO, CH4, NO2, H2O2, H2CO, O3, and bromine oxides can be measured with ppb sensitivity. Both QEPAS and ECqcL

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technologies are amenable to miniaturization, monolithic construction, and mass production following a straightforward engineering path using established MEMS technologies. The result would be a small, battery-operated, rugged sensor package that can be mass produced at low cost. The sensor would be insensitive to environmental factors and deployment platform independent. Wireless communication, self-calibration, and remote servicing are inherent components of such a miniaturized monolithic sensor package.

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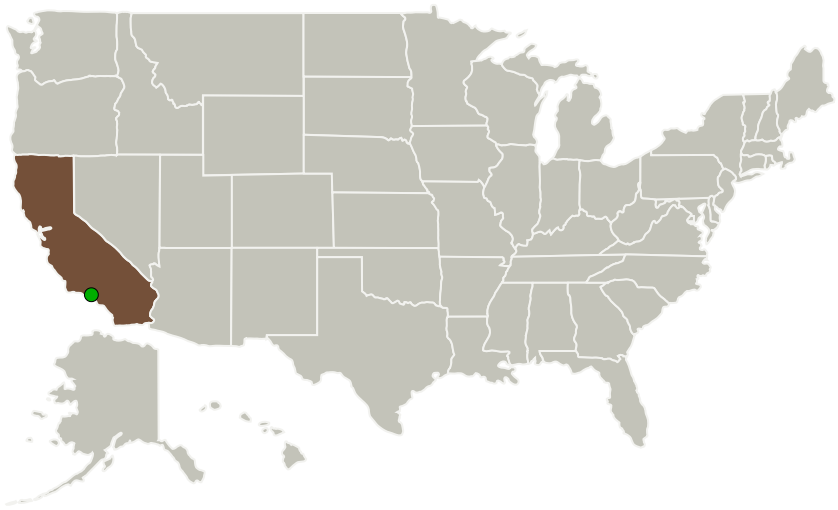
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Daylight Solutions	Lead Organization	Industry	San Diego, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138309)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Daylight Solutions

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

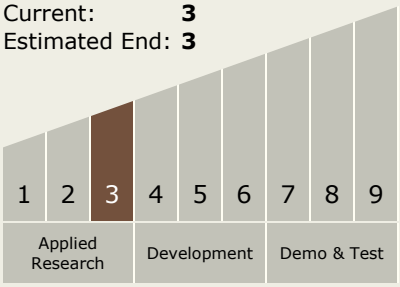
Carlos Torrez

Principal Investigator:

Miles Weida

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.5 Lasers

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System